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09/488,309	01/20/2000	Imad Mahawili PhD	MIC04 P-106	4253

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EXAMINER
GOUDREAU, GEORGE A

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1763	10

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Please find below and/or attached an Office communication concerning this application or proceeding.

GC

Office Action Summary

Application No.	Applicant(s)
09-488,309	Mahawili
Examiner	**Group Art Unit**
George Goudreau	1763

—The MAILING DATE of this communication appears on th cover sheet beneath the correspondence address—

P riod for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 (MONTH(S)) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, such period shall, by default, expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

☒ Responsive to communication(s) filed on 2-02' (ie, - paper #9)

☐ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle,* 1935 C.D. 1 1; 453 O.G. 213.

Disposition of Claims

☒ Claim(s) 1-77 is/are pending in the application.

Of the above claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1-21, 24-37, 39-62, 64-77 is/are rejected.

☒ Claim(s) 22-23, 38, 63 is/are objected to.

☐ Claim(s) _____ are subject to restriction or election requirement

Application Papers

☐ Th proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner

☐ Th specification is objected to by the Examiner.

☐ Th oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119 (a)-(d)

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119 (a)-(d).

☐ All ☐ Some* ☐ None of the:

☐ Certified copies of the priority documents have been received.

☐ Certified copies of the priority documents have been received in Application No. _____.

☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a))

*Certified copies not received: _____.

Atta hment(s)

☒ Information Disclosure Stat m nt(s), PTO-1449, Paper No(s). 3,7

☒ Notice of Ref rence(s) Cited, PTO-892

☐ Notice of Draftsperson's Pat nt Drawing Review, PTO-948

☐ Interview Summary, PTO-413

☐ Notice f Informal Patent Applicati n, PTO-152

☐ Other _____

Office Acti n Summary

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371© of this title before the invention thereof by the applicant for patent.

16. Claims 1, 4-12, 15-16, 20-21, 24-27, 32-34, 36, 40-42, 44, 47, 53, 57-58, 64, 67-69, 72-73, and 75 are rejected under 35 U.S.C. 102(b) as being anticipated by Taleb et. al. (FR 2,715,168).

Taleb et. al. disclose a PECVD process, and a PECVD apparatus for depositing a conductor (i.e.-metal, etc.) onto the surface of a semiconductor substrate (14) after the semiconductor substrate has been pretreated in-situ with a N2 plasma. The N2 plasma is used to remove contaminants such as oxides which were formed onto the surface of the semiconductor substrate in order to reduce the amount of series resistance which occurs between the surface of the conductor and the surface of the wafer. The metal is PECVD deposited onto the surface of the wafer by combining an ionized N2 gas stream with a non-ionized gaseous organometallic compound (i.e.-diethylene zinc, etc.) in-situ inside the processing chamber. The ionized N2 is formed by supplying N2 from a N2 supply tank (1) to a quartz plasma generation tube (3) where the N2 is excited using microwaves which are emitted from a magnetron (4) which is coupled to the quartz plasma generation tube (3) using a multi-mode coupler (6). The gaseous

organometallic compound is supplied to the processing chamber from a supply tank (7) using a second gas injection tube (10). The second gas injection tube (10) is comprised of a coiled tube which has a series of gas orifices located on it along its length which are used to introduce the organometallic gas into the process chamber. The flow rate of the N2 gas, and the organometallic gas into the processing chamber are varied using flow control valves (2, 8). The waste process gas is exhausted from the processing chamber using an exhaust pump (11). This is shown in figures 1-5. This is discussed specifically in the abstract, and discussed in general on pages 1-11.

17. Claims 1-14, 15-21, 24-36, 39-45, 48-50, 53, 55-58, 64-70, and 72-75 are rejected under 35 U.S.C. 102(b) as being anticipated by Yukimoto (JP 56-102,577).

Yukimoto discloses a process, and apparatus for the thermally enhanced, PECVD deposition of an amorphous Si film onto the surface of a semiconductor wafer (6) which has been previous pretreated in-situ with a plasma of CF4. The CF4 plasma is used to remove contaminants such as oxides which were formed onto the surface of the semiconductor substrate in order to reduce the amount of series resistance which occurs between the surface of the amorphous Si film and the surface of the wafer. The amorphous Si film is formed by supplying an ionized gas mixture to the processing chamber (1) as well as a non-ionized gas mixture. The ionized gas mixture is created in an external quartz, plasma generation chamber in which the plasma is formed using an RF inductively coupled electrode (9). The gas mixture is formed by selectively combining B2H2-H2, PH3-H2, and SiH4-H2 gas streams with each other externally to the processing chamber. Mass flow controllers (12-14, 20-21) are used to vary the flow rate of

the gas mixture into the processing chamber during the PECVD process as well as to regulate the flow on individual gas streams relative to each other. The ionized gas mixture is admitted to the processing chamber using a quartz shower head (8) which is equipped with a series of nozzles along its length. The gas mixture is additionally excited in-situ in the processing chamber (1) using parallel plate electrodes (2) which are located external to the processing chamber (1). Additionally, a substrate heater (5) is used to heat up the wafer in-situ in order to further promote the PECVD reaction on the surface of the substrate. Waste process gasses are exhausted from the processing chamber (1) through an exhaust port (22) using a rotary exhaust pump (3). This is discussed specifically in the abstract; and discussed in general on pages 405-408. This is shown in figure 1.

18. Claims 1, 4-7, 15-16, 24-27, 32-34, 36-37, 40-42, 48, 50, 53, 57-58, 64, 67-69, 72-73, and 75 are rejected under 35 U.S.C. 102(b) as being anticipated by Sano (US 4,942,058).

Sano discloses a PECVD process, and apparatus for CVD depositing a Si film onto the surface of a wafer using a plasma mixture comprised of F2, H2, and a Si halide type compound. Each of these gasses is remotely excited to form a plasma which is then fed to the processing chamber where the gasses are mixed together adjacent the wafer (105) to be processed. The Si halide type compound is supplied via supply tube 102. The H2 gas is supplied via supply tube 103. The F2 gas is supplied via supply tube 111. The flow rates of the different gasses from their plasma generation chambers are regulated. The substrate is rotated on rollers (110) during the PECVD process. The F gas is used to etch the substrate during the PECVD process. This is

shown specifically in figure 1, and shown in general in figures 1-6. This is discussed specifically in column 7, and discussed in general in columns 1-12.

19. Claims 1-12, 15-18, 20, 24-36, 39-43, 45-46, 51, 53, 55, 57-58, 60-62, 64-70, 72-73, 75, and 77 are rejected under 35 U.S.C. 102(e) as being anticipated by Ui et. al. (US 5,976,992).

Ui discloses a process, and an apparatus for the thermally enhanced, PECVD formation of a SiO2 film onto the surface of a wafer (105) using a plasma which is comprised of O2, and TEOS. The O2 is excited into a plasma using an RF inductively coupled coil which surrounds a plasma generation tube which is used to inject excited O2 into the processing chamber (102). A second gas injection tube (101) is used to inject non-excited TEOS gas into the processing chamber. The two gasses are mixed together adjacent the surface of the wafer. Valves are placed on each of the gas injection tubes in order to regulate the flow of each gas into the processing chamber. A substrate heater (104) is used to heat the wafer during the PECVD process, and thereby enhance the rate of deposition of the SiO2 film onto the surface of the wafer. The wafer process gas is exhausted from the processing chamber using an exhaust pump (109). This is shown specifically in figure 1, and shown in general in figures 1-34. This is discussed specifically in column 4, and discussed in general in columns 1-22.

Ui discloses a process, and an apparatus for the thermally enhanced, PECVD formation of a SiO2 film onto the surface of a wafer (14) using a plasma which is comprised of TEOS

(i.e.-silane), and O2. The O2 gas is formed inside a first plasma generation zone (10) using an RF excited electrode. The TEOS gas is injected into the process chamber using an injection tube (11) which surrounds the plasma generation chamber used to excite the O2. At the end of each of the gas injection tubes (10, 11) is a nozzle which is comprised of a disc (16 b) with holes. The plasma mixture is injected into the processing chamber (12) using the gas nozzle (16). A wafer which rests on a support in the processing chamber (12) is heated using a heater (15). This is shown specifically in figure 4, and shown in general in figures 1-34. This is discussed specifically in columns 10-11, and discussed in general in columns 1-22.

20. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

21. Claims 17-18, 35, 37, 43, and 59-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over the reference as applied in paragraph 16 above.

The reference as applied in paragraph 16 above fail to disclose the following aspects of applicant's claimed invention:

-the specific rotation of the substrate during the PECVD process;

-the specific formation of the plasma in the plasma generation tube using a RF inductively coupled coil; and

-the specific varying of the flow rate of the ionized gas to the processing chamber during the PECVD step

It would have been obvious to one skilled in the art to rotate the wafer during the PECVD process taught above based upon the following. The usage of wafer rotation means during a CVD process is conventional or at least well known in the semiconductor processing arts. (The examiner takes official notice in this regard.) Further, this simply represents a means for desirably improving the uniformity of deposition of the CVD coating onto the surface of the substrate by rotating the substrate such that different portions of the surface of the substrate are exposed to the plasma over time.

It would have been obvious to one skilled in the art to employ an RF inductively coupled coil to generate the plasma in the plasma generation chamber in the process taught above based upon the following. The usage of an RF inductively couple coil to generate a plasma in a plasma generation chamber is conventional or at least well known in the plasma generation arts. (The examiner takes official notice in this regard.) Further, this simply represents the usage of an alternative, and at least equivalent means for forming the plasma in the process taught above to those means which are specifically taught above.

It would have been obvious to one skilled in the art to vary the flow rate of the different process gasses in the process taught above such that the optimum process parameters for forming a film in the process taught above are achieved based upon the following. It is conventional or at least well known in the CVD art to optimize various process parameters such as gas flow rates in

order to achieve optimum results in the film which is formed. The examiner cites the case law listed below of interest to the applicant in this regard.

"Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F. 2d 454, 105 USPQ 233, 235 (CCPA).

22. Claims 37, 59-62, and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over the reference as applied in paragraph 17 above.

The reference as applied in paragraph 17 above fail to disclose the following aspects of applicant's claimed invention:

-the specific rotation of the substrate during the PECVD process

It would have been obvious to one skilled in the art to rotate the wafer during the PECVD process taught above based upon the following. The usage of wafer rotation means during a CVD process is conventional or at least well known in the semiconductor processing arts. (The examiner takes official notice in this regard.) Further, this simply represents a means for desirably improving the uniformity of deposition of the CVD coating onto the surface of the substrate by rotating the substrate such that different portions of the surface of the substrate are exposed to the plasma over time.

23. Claims 9, 13-14, 17-18, 35, 43, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over the reference as applied in paragraph 18 above.

The reference as applied in paragraph 18 above fail to disclose the following aspects of applicant's claimed invention:

-the specific construction of the gas injection tube out of quartz;

-the specific usage of an RF inductively coupled coil to generate the plasma in the plasma generation chamber;

-the specific usage of CF4 as the F based gas in the processing gas mixture, and

-the specific varying of the flow rate of the ionized gas to the processing chamber during the PECVD step

It would have been obvious to one skilled in the art to form the gas injection tubes in the process taught above out of quartz based upon the following. It is conventional or at least well known to form the components of a plasma generation apparatus out of inert materials such as quartz. (The examiner takes official notice in this regard.) Further, this simply represents the usage of an alternative, and at least equivalent means for forming the gas injection tubes in the process taught above to the specific usage of other such means.

It would have been obvious to one skilled in the art to use Freon (i.e.-CF4) as the F gas source in the process taught above. The usage of Freon in the fabrication of semiconductors is conventional or at least well known in the semiconductor processing arts. (The examiner takes

official notice in this regard.) Further, this reference broadly teaches that any F based compound may be used in their process.

It would have been obvious to one skilled in the art to employ an RF inductively coupled coil to generate the plasma in the plasma generation chamber in the process taught above based upon the following. The usage of an RF inductively couple coil to generate a plasma in a plasma generation chamber is conventional or at least well known in the plasma generation arts. (The examiner takes official notice in this regard.) Further, this simply represents the usage of an alternative, and at least equivalent means for forming the plasma in the process taught above to those means which are specifically taught above.

It would have been obvious to one skilled in the art to vary the flow rate of the different process gasses in the process taught above such that the optimum process parameters for forming a film in the process taught above are achieved based upon the following. It is conventional or at least well known in the CVD art to optimize various process parameters such as gas flow rates in order to achieve optimum results in the film which is formed. The examiner cites the case law listed below of interest to the applicant in this regard.

"Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F. 2d 454, 105 USPQ 233, 235 (CCPA).

24. Claims 37, 56, 59, and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over the reference as applied in paragraph 19 above.

The reference as applied in paragraph 19 above fail to disclose the following aspects of applicant's claimed invention:

-the specific rotation of the substrate during the PECVD process; and

-the specific varying of the flow rate of the ionized gas to the processing chamber during the PECVD step

It would have been obvious to one skilled in the art to rotate the wafer during the PECVD process taught above based upon the following. The usage of wafer rotation means during a CVD process is conventional or at least well known in the semiconductor processing arts. (The examiner takes official notice in this regard.) Further, this simply represents a means for desirably improving the uniformity of deposition of the CVD coating onto the surface of the substrate by rotating the substrate such that different portions of the surface of the substrate are exposed to the plasma over time.

It would have been obvious to one skilled in the art to vary the flow rate of the different process gasses in the process taught above such that the optimum process parameters for forming a film in the process taught above are achieved based upon the following. It is conventional or at least well known in the CVD art to optimize various process parameters such as gas flow rates in order to achieve optimum results in the film which is formed. The examiner cites the case law listed below of interest to the applicant in this regard.

"Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F. 2d 454, 105 USPQ 233, 235 (CCPA).

25. Claims 52, 54, and 76-77 are rejected under 35 U.S.C. 103(a) as being unpatentable over the references as applied in any of paragraphs 16-19, 21-24 above.

The references as applied in any of paragraphs 16-19, 21-24 above fail to specifically disclose the usage of the usage of an ammonia based plasma which is combined with silane in-situ in the PECVD process chambers taught above to form a Si3N4-silane based plasma in the process chamber which is used to fabricate a Si3N4 film onto the surface of a wafer.

It would have been obvious to one skilled in the art to employ a plasma comprised of both ammonia, and silane in any of the PECVD apparatuses taught above in the fabrication of a Si3N4 film onto the surface of a wafer based upon the following. The usage of a plasma comprised of ammonia, and silane to form a silane film onto the surface of a wafer is conventional or at least well known in the semiconductor processing arts. (The examiner takes official notice in this regard.) Further, this simply represents the usage of an alternative, and at least equivalent means for forming a Si3N4 film onto the surface of a wafer to the specific usage of other such means for doing such.

26. Claims 22-23, and 38, and 63 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

27. Claims 49, 53-56, 58, and 62 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

-In line 2 of claim 49, the term "hydrogen Freon" is confusing, and should be reworded.;

-In line 1 of claim 53, the term "said heater" lacks proper antecedent basis.; and

-In line 1 of claims 58, and 62, the term "magnetic" should read "electromagnetic".

28. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner George A. Goudreau whose telephone number is (703) -308-1915. The examiner can normally be reached on Monday through Friday from 9:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Examiner Gregory Mills, can be reached on (703) -308-1633. The appropriate fax phone number for the organization where this application or proceeding is assigned is (703) -306-3186.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) -308-0661.

George A. Goudreau/gag

Primary Examiner

AU 1763